

California N Index:

*A Tool to Assess N Management
for Environmental Conservation*

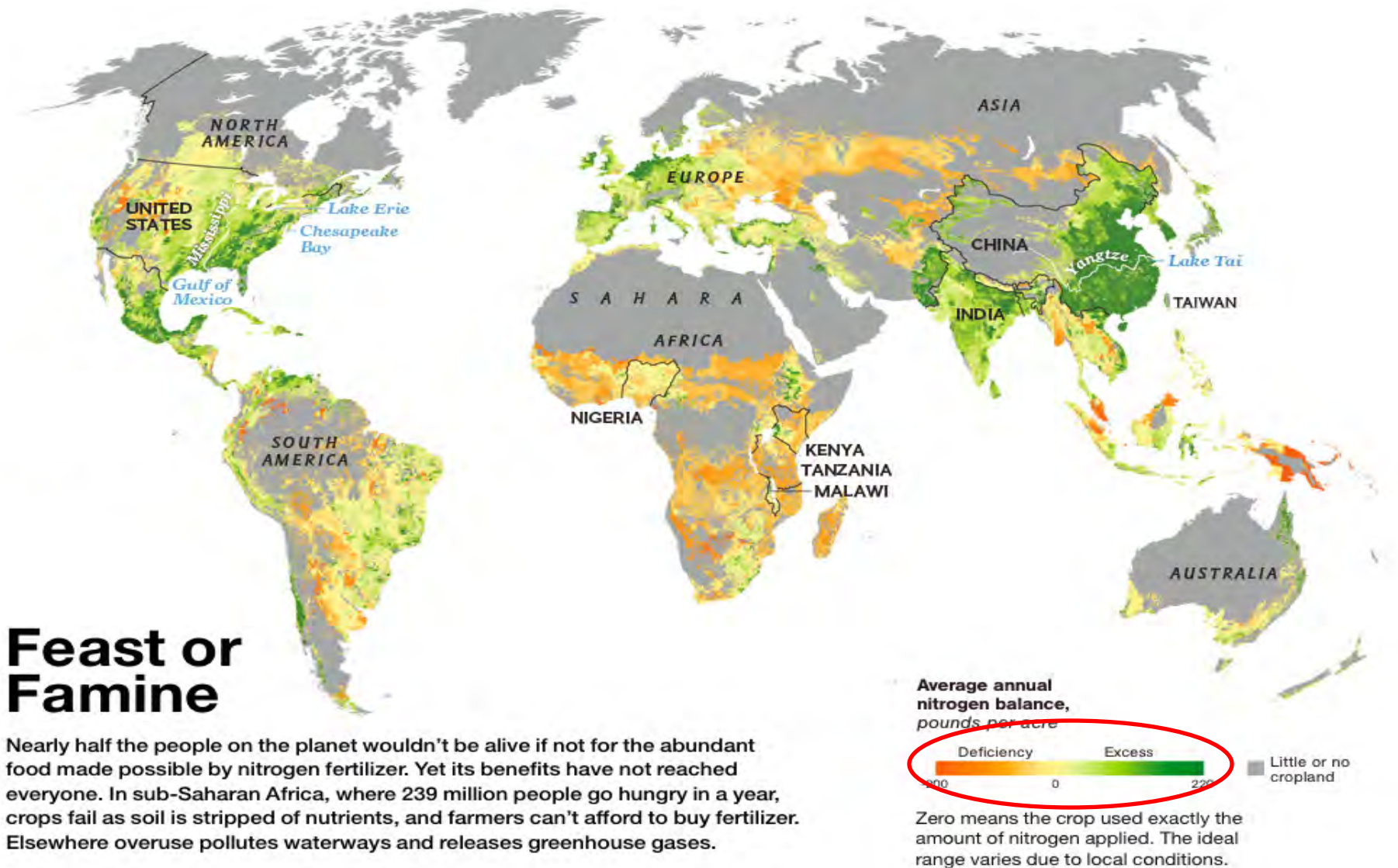
Z. Kabir, D. Chessman and J. Delgado
USDA-NRCS and USDA-ARS



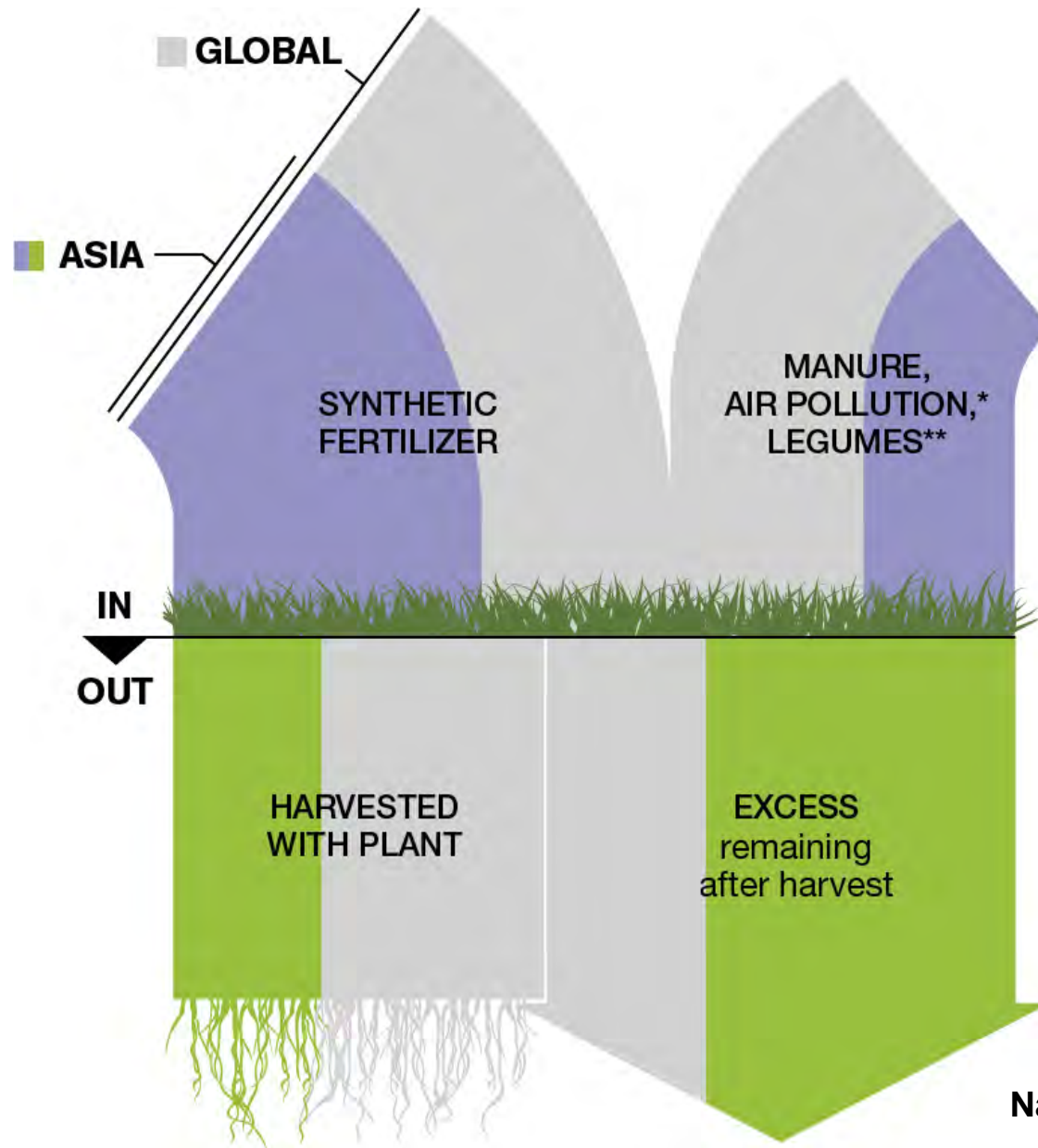
N Fertilizer

- **Nitrogen is the engine of modern Agriculture**
- **All Plants & Animals need N to make their proteins, DNA and RNA**
- **However, if we don't watch out, N fertilizer could destroy our planet**

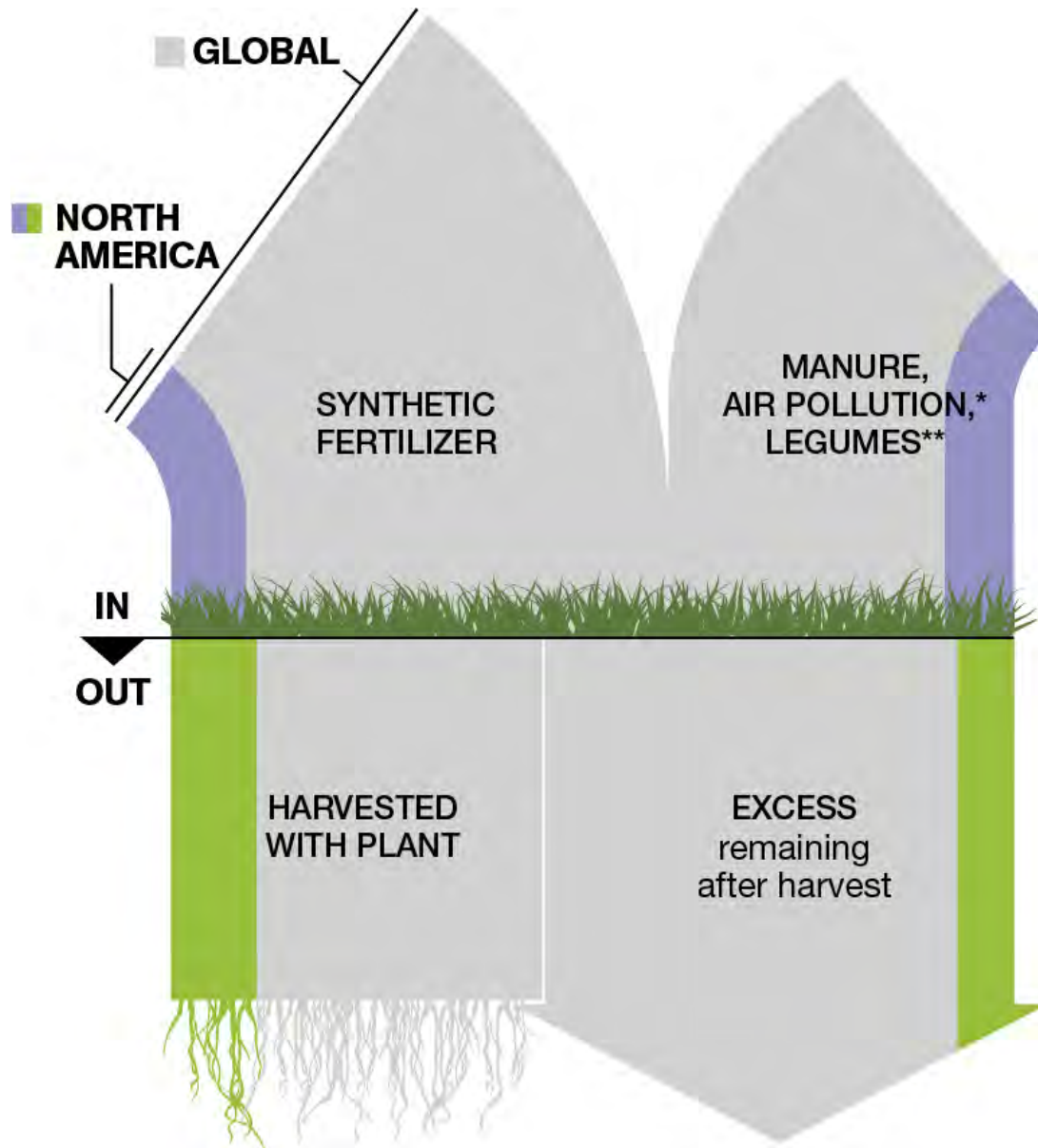
Global N Balance



The Flow of Nitrogen

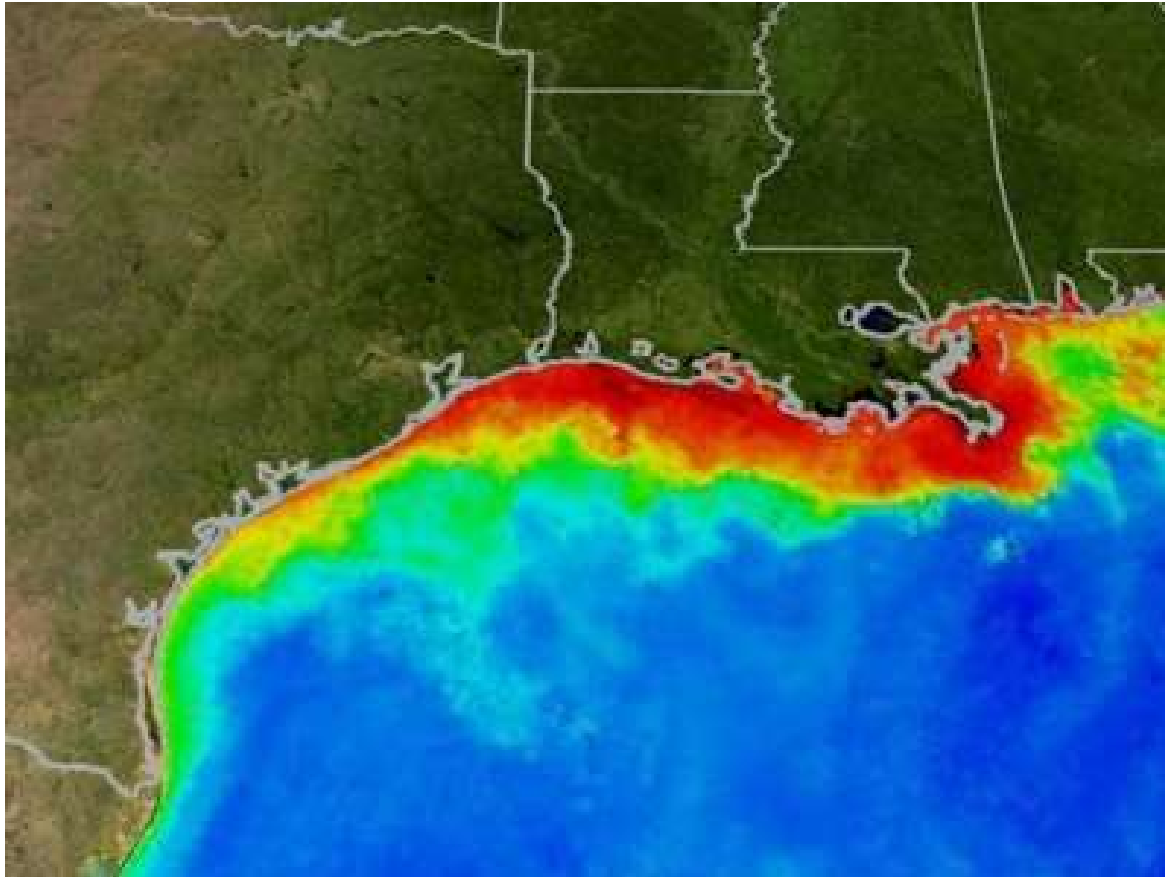


The Flow of Nitrogen





Eutrophication at Gulf Coast Water



The map shows concentrations of phytoplankton, the algal blooms that contribute to dead zones, in Gulf Coast waters.



Satellite view of 2011 massive Lake Erie algal bloom, caused chiefly by N & P runoff from fertilizer/manure.

Lake Erie Becomes Eerie





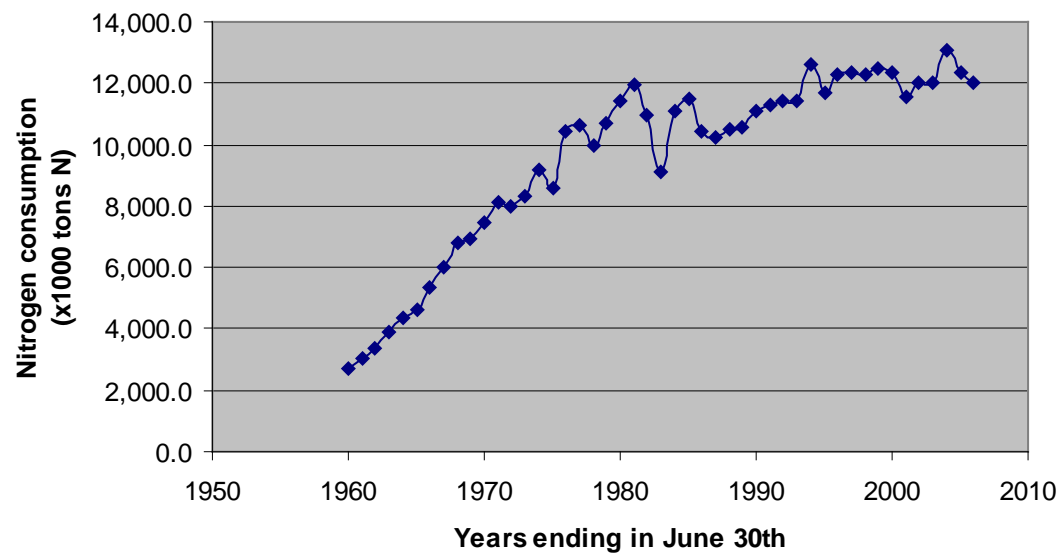
High N & P levels in Maumee and Sandusky rivers from Ag fields that drain into Lake Erie







U.S. consumption of Nitrogen



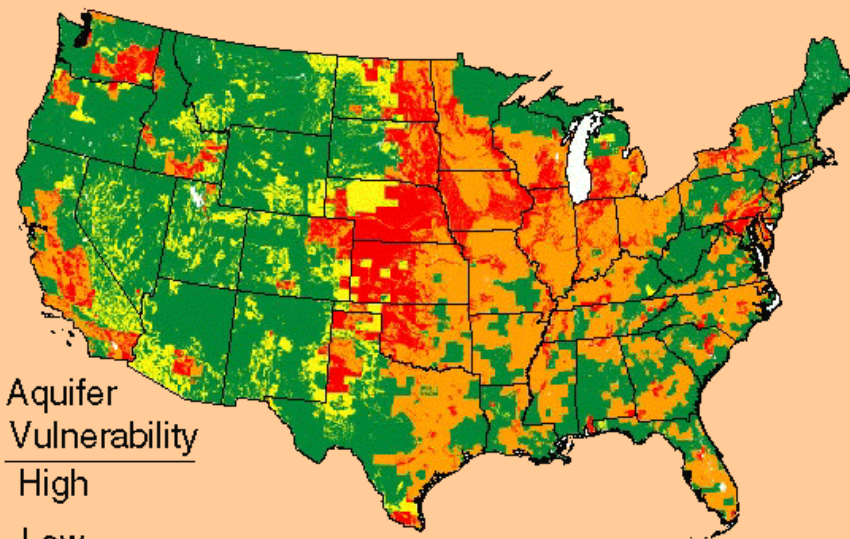
Increasing risk of ground-water contamination

Nitrogen
Input

High
High
Low
Low

Aquifer
Vulnerability

High
Low
High
Low



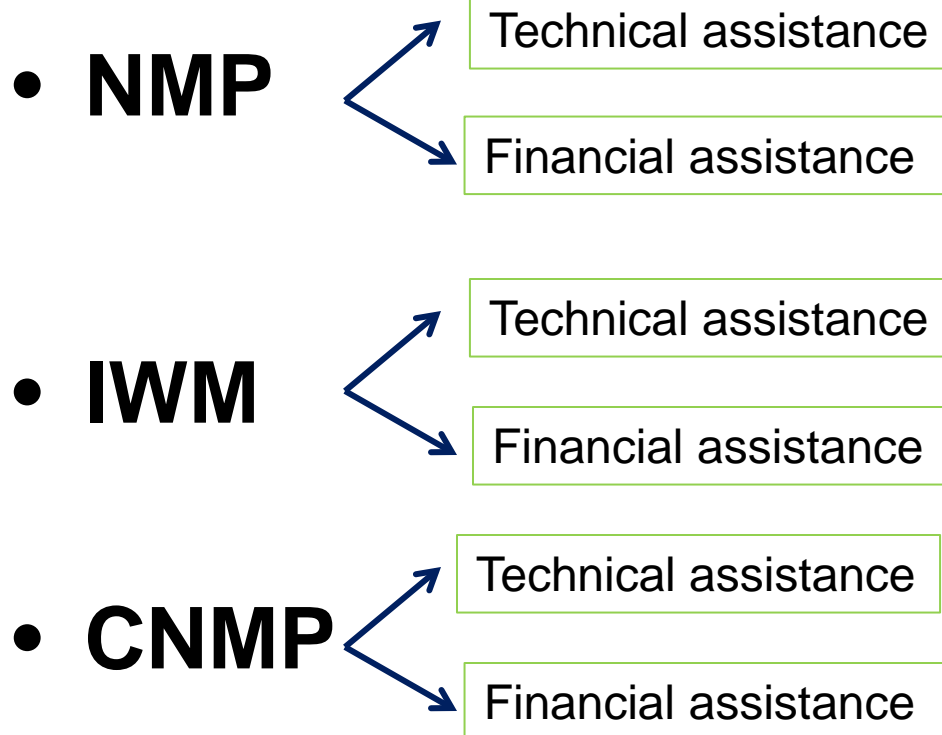


USDA-NRCS

- **Nutrient Management Plan (NMP)**
- **Irrigation Water Management (IWM)**
- **Comprehensive Nutrient Management Plan (CNMP)**



USDA-NRCS





USDA-NRCS

- **NMP**
 - Financial Assistance- 8 scenarios of payments
- **IWM**
 - Financial Assistance- 10 scenarios of payments
- **CNMP**
 - Land treatment
 - Nutrient management
 - Waste management



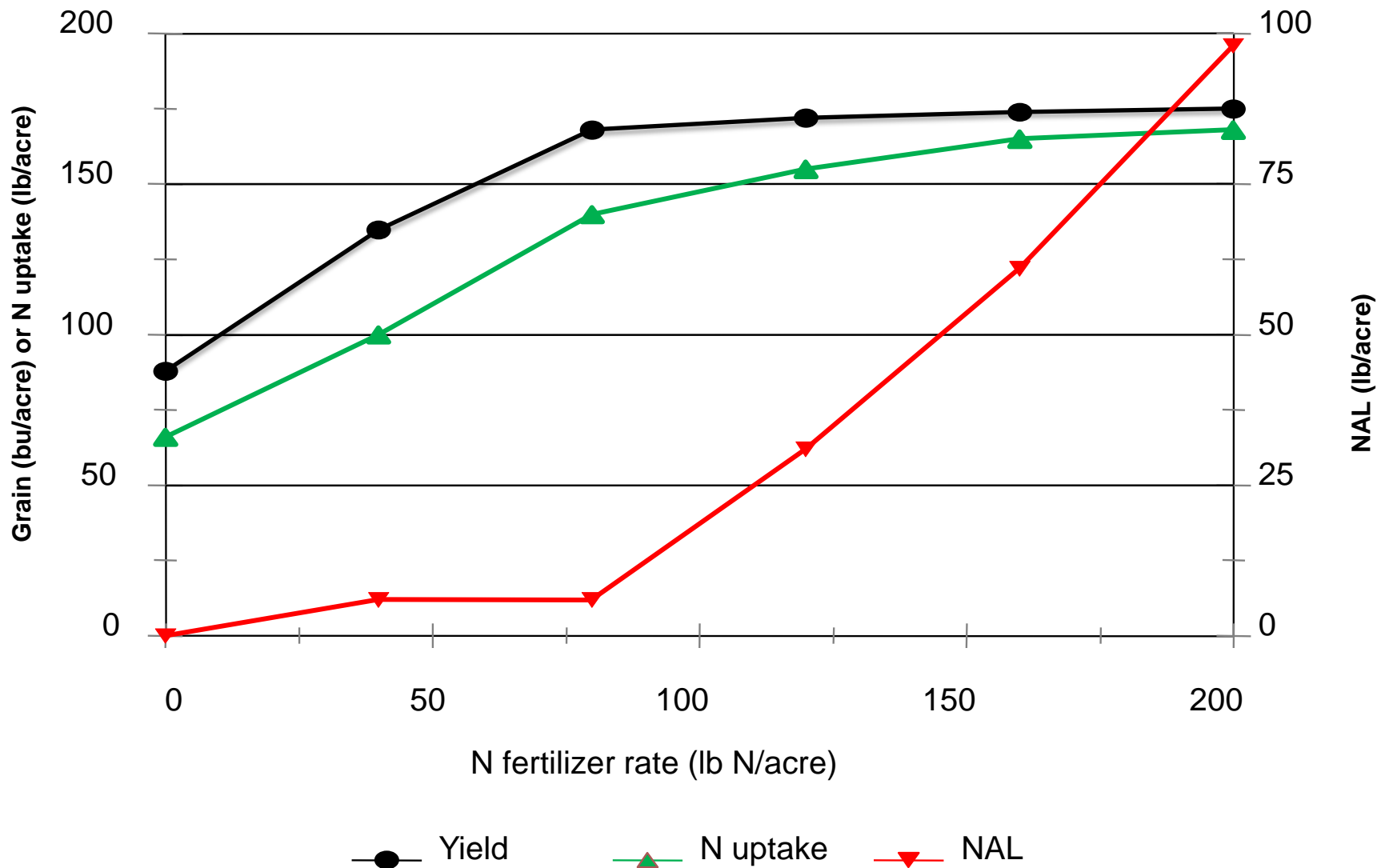
Screening and ranking

Nitrate Ground Water Pollution Hazard Index (HI) Tool

- Crop Characteristics
- Soil Properties
- Type of Irrigation System use
- Tillage practices

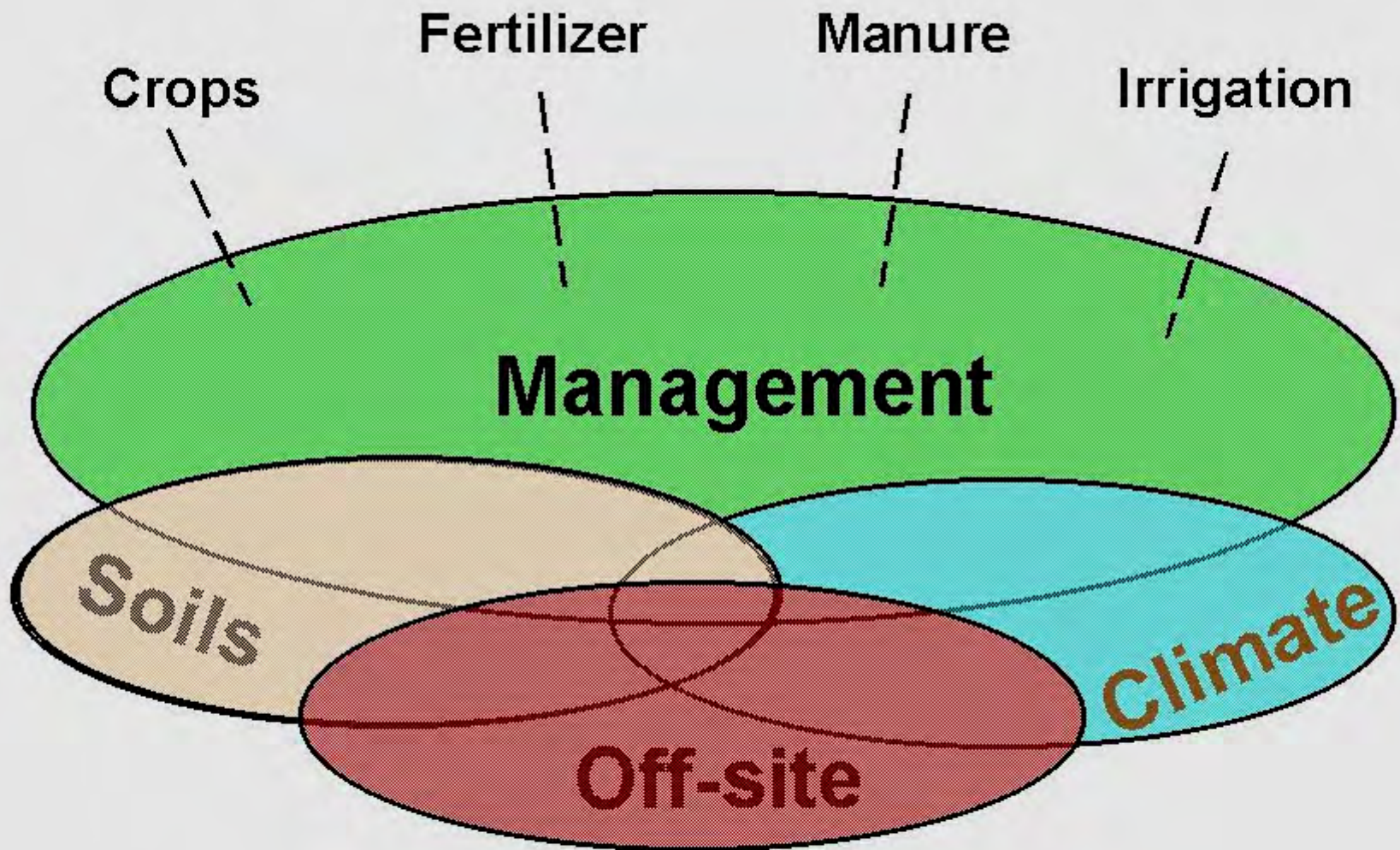
Do not considered HI Tool

- Depth to groundwater
- Aquifer Recharge Rate
- Farm Management Practices

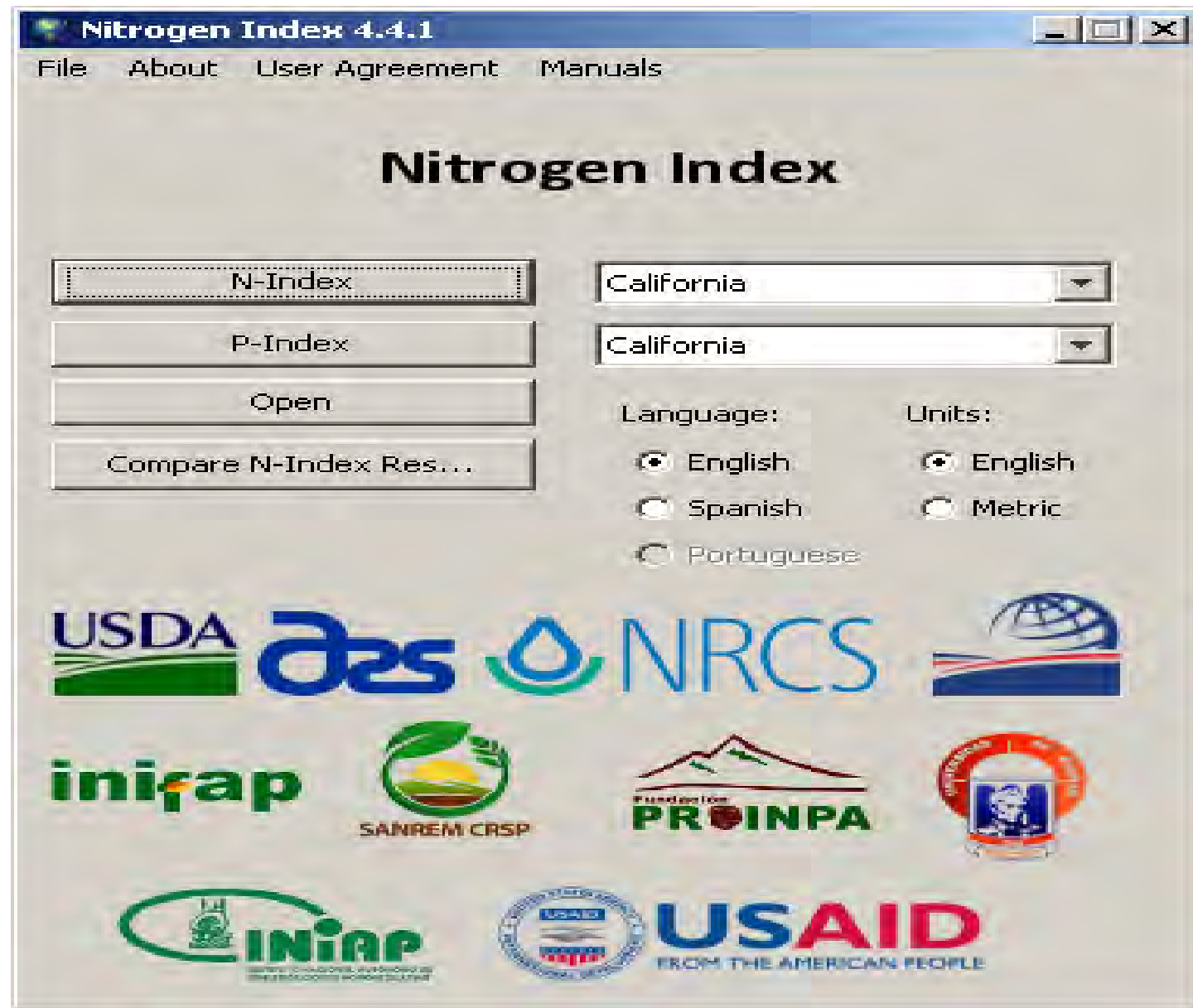


Effect of N fertilizer rate applications on yield and N uptake by irrigated corn (Adapted from Bock and Hergert, 1991). Potential N available to leach (NAL) assuming major pathway for losses is leaching. The NAL was estimated as $NAL = N \text{ applied} - N \text{ uptake}$.

N-Index







Essential components of N index (NI) (From Shaffer and Delgado, 2002)



A JAVA version of the Nitrogen Index. The Nitrogen Index has a dropdown menu that can be used to select a region (such as California) and its accompanying data. Users can alternate between English and Spanish versions of the menu just by clicking the desired language.

Silage Corn-Winter Forage Cropping System

 **California Nitrogen Index 4.4.1** | **Basic Information**   

Name	<input type="text" value="XYZ Dairy"/>		
Location	<input type="text" value="Somewhere in Ca"/>		
Date	<input type="text" value="05/15/2013"/>	<input type="button" value="Today"/>	
Scenario	<input type="text" value="Corn-Winter Forage"/>		
Price: \$ / lbs N	<input type="text" value="0.6"/>		

Specific Treatments



California Nitrogen Index 4.4.1 | Soil



Soil Layer:

ppm



#1

#2

#3

Soil Depth

1

feet

Organic Matter

2.43

%

Soil PH

7.6

N-O3N

12

ppm

SOM N Rate

40

NH4-N

0

ppm

Bulk Density

1.2

g/cm3

Save

Current Year

☒ Applied Application

CA-Average

Gallons

NH4-N 2 lbs N/1k gal Amount 27000 gal/ac

Total N 3 lbs N/1k gal WEP 0.65

P2O5 4 lbs P2O5/1k gal

% Release (1st/2nd Year) 30.0 15.0

☒ Surface Applied☐ Incorporated☒ Default☐ Custom

AVC 12.0

☒ Applied Application

CA-Average

in/acre

NH4-N 230.0 ppm Amount 27000 in/ac

Total N 330.0 ppm WEP 0.65

P2O5 500.0 ppm

% Release (1st/2nd Year) 30.0 15.0

☐ Surface Applied☒ Incorporated☒ Default☐ Custom

AVC 2.0

Previous Year

☒ Applied Application

CA-Average

Gallons

NH4-N 2 lbs N/1k gal Amount 27000 gal/ac

Total N 3 lbs N/1k gal WEP 0.65

P2O5 4 lbs P2O5/1k gal

% Release (1st/2nd Year) 30.0 15.0

☒ Surface Applied☐ Incorporated☒ Default☐ Custom

AVC 12.0

☒ Applied Application

CA-Average

Gallons

NH4-N 2 lbs N/1k gal Amount 27000 gal/ac

Total N 3 lbs N/1k gal WEP 0.65

P2O5 4 lbs P2O5/1k gal

% Release (1st/2nd Year) 30.0 15.0

☐ Surface Applied☒ Incorporated☒ Default☐ Custom

AVC 2.0

Save



Application:

#1

#2

#3

#4

#5

Source of N and Method of Application

Other NH₄ Sources

☒ Applied Application

Rain / Irrigation during Application

Amount lbs N/ac

No rain/irrigation within 7 days

☐ Controlled Release Fertilizer

☐ Nitrification Inhibitor

☐ Split Fertilizer

AVC ☒ Default

☐ Custom

Save



California Nitrogen Index 4.4.1

Irrigation



Irrigation Type

Furrow with Tail Water Collection



ppm



Pre-Plant Irrigation

4

inches

WC

1.0

Post-Plant Irrigation

53.24

inches

WC

1.0

Concentration NO3-N

8

ppm

Concentration of Organic N

0

ppm

Expected N Release from Organic N

0

%

Save

Root Depth of Deepest Rooted Crop Inches

Crop #1

☒ Crop

Alfalfa-Green Chop

Clover-Red-Hay-Sun

Clover-White-Green-Chop

Clover-White-Hay-Sun

Corn-Winter-Forage

Corn-Grain

Corn-Grain (SD)

Corn-Silage

Corn-Silage (CA)

☐ Crop

Alfalfa-Green Chop

Yield (Wet Weight) ☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H₂O

75.0

NUI

18

Residue of Previous Crop #1

☐ Crop

Alfalfa-Green Chop

C/N Time of Incorporation

☒ < 30☐ > 30Yield (Wet Weight) ☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H₂O

75.0

NUI

18

Residue of Previous Crop #2

☐ Crop

Alfalfa-Green Chop

C/N Time of Incorporation

☒ < 30☐ > 30Yield (Wet Weight) ☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H₂O

75.0

NUI

18

Crop #3

☐ Crop

Alfalfa-Green Chop

Yield (Wet Weight) ☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H₂O

75.0

NUI

18

Residue of Previous Crop #3

☐ Crop

Alfalfa-Green Chop

C/N Time of Incorporation

☒ < 30☐ > 30Yield (Wet Weight) ☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H₂O

75.0

NUI

18

Save



California Nitrogen Index 4.4.1 | Crop

Root Depth of Deepest Rooted Crop 36 Inches

Crop #1

☒ Crop

Corn-Silage (CA)

Yield (Wet Weight) 32

☐ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H2O

70.0

NUI

8.2

Residue of Previous Crop #1

☒ Crop

Rye-Winter (SD)

Yield (Wet Weight) 1

☐ Leguminous

Unit

Bu

Weight/Unit

60.0

% H2O

12.0

NUI

2.3

C/N Time of Incorporation

☒ < 30

☐ > 30

Crop #2

☒ Crop

Rye-Winter (SD)

Yield (Wet Weight) 15

☐ Leguminous

Unit

Bu

Weight/Unit

60.0

% H2O

12.0

NUI

2.3

Residue of Previous Crop #2

☒ Crop

Corn-Silage (CA)

Yield (Wet Weight) 2

☐ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H2O

70.0

NUI

8.2

C/N Time of Incorporation

☒ < 30

☐ > 30

Crop #3

☐ Crop

Alfalfa-Green Chop

Yield (Wet Weight)

☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H2O

75.0

NUI

18

Residue of Previous Crop #3

☐ Crop

Alfalfa-Green Chop

Yield (Wet Weight)

☒ Leguminous

Unit

Ton

Weight/Unit

2000.0

% H2O

75.0

NUI

18

C/N Time of Incorporation

☒ < 30

☐ > 30

Save



California Nitrogen Index 4.4.1 | **Off-Site Factors**

Travel Time to Aquifer
Long (>15 Years)

Long (>15 Years)
Moderate (5-15 Years)
Short (<5 Years)

Vulnerability of Aquifer
III: Unlikely Drinking Water

Denitrification Coefficient: 8.0
K Constant: 1.2

Default
Custom
Default
Custom

Save

Annual Atmospheric Wet/Dry N Deposition: lbs N/acre



Hydrology A

- Hydrology A
- Hydrology B
- Hydrology C
- Hydrology D

Sand, Loamy sand, or Sandy loam typ

by excessively
s or gravelly
soils, or sands
over a coarse gravelly
substratum.

Precipitation While Crop Growing

inches WC

Precipitation While No Crop Growing

inches WC

Climate
Humid

☐ Tile Drainage

Hydrology Characteristics
Excessively well drained

Save

California Nitrogen Index 4.4.1 | Qualitative Factors

Vegetative Buffer

> 100 feet wide

Proximity of Nearest Field Edge to Named Stream or Lake

Very low (> 1000 feet)

Runoff Class (Runoff Class Table)

Low

Rooting Depths and Crop Rotation

3.5 - 5 feet AND rotation with shallower crops

Soil Erosion (Wind & Water)

Very low (< 1 t/ac)

Very low (< 1 t/ac)

Low (1 - 3 t/ac)

Medium (> 3 - 7 t/ac)

High (> 7 - 15 t/ac)

Very high (> 15 t/ac)

Nitrogen Application Rate

Yield goal respective to UC Rate AND tissue/soil test in season

Volatilization Susceptible N Application Method

None applied

Tile Drainage

No tile drainage

Irrigation Erosion

No irrigation OR negligible sediment erosion

Save

Qualitative Results

Nitrate Leaching

>45

>33-45

>22-33

>10-22 **16**

0-10



Surface Transport

>34-41

>28-34

>15-28 **18**

>7-15

0-7



Atmospheric

>28-33

>22-28

>15-22 **16**

>7-15

0-7



Total

>107

>83-107

>52-83

>24-52 **50**

0-24



N2O Index

Interpretation of Rankings

Definitions of Outputs

Economic Assessment

Ranking Matrix

Save File

Generate Report

Quantitative Results

Total N System In **337** lbs N / a y

Ammonia Volatilization **8** lbs N / a y

Denitrification **27** lbs N / a y

Above Ground Uptake **302** lbs N / a y

Ratio N Applied to N Removed by Crop **0.55**

Leaching Index (LI) **18.9** inches





Total Nitrogen Leached **0** lbs N / a y

Residual Nitrate **0** lbs N / a y

System Use Efficiency **90** %



Vegetable Grower

 **California Nitrogen Index 4.4.1 | Basic Information**   

Name

Location

Date

Scenario

Price: \$ / lbs N

Specific Treatments

California Nitrogen Index 4.4.

Soil Layer:

#1 #2 #3

Soil Depth feet
Organic Matter %
N-O3N ppm
NH4-N ppm
Bulk Density g/cm3

Save

California Nitrogen Index 4.4.1 | Fertilizer

Application:

#1 #2 #3 #4 #5

☒ Applied Application

Source of N and Method of Application

Urea Surface

Rain / Irrigation during Application

1/2+ inch of rain/irrigation within 2 days

Amount lbs

☐ Controlled Release Fertilizer

☐ Nitrification Inhibitor

☒ Split Fertilizer

AVC

☒ De

☐ Cu

Save

California Nitrogen Index 4.4.1 | Irrigation

Irrigation Type ppm

Pre-Plant Irrigation inches WC

Post-Plant Irrigation inches WC

Concentration NO3-N ppm

Concentration of Organic N ppm

Expected N Release from Organic N %

Save

California Nitrogen Index 4.4.1 | Dry Manure

Current Year

☒ Applied Application

Organic Fertilizer/Compost (...)

lbs N

Wet Weight ton/a % Moisture

NH4-N DB lbs WEP

Total N DB lbs P2O5 DB lbs

% Release (1st/2nd Year)

☐ Surface Applied

AVC

☐ Default

☒ Incorporated

☒ Custom

Previous Year

☒ Applied Application

Organic Fertilizer/Compost (...)

lbs N

Wet Weight ton/a % Moisture

NH4-N DB lbs WEP

Total N DB lbs P2O5 DB lbs

% Release (1st/2nd Year)

☐ Surface Applied

AVC

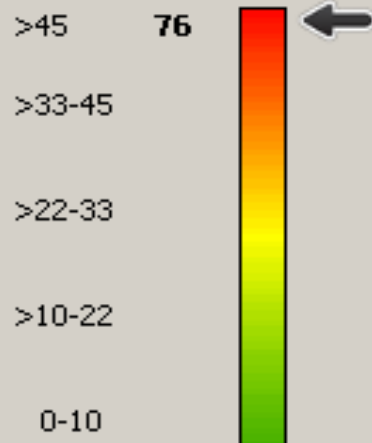
☒ Default

☒ Incorporated

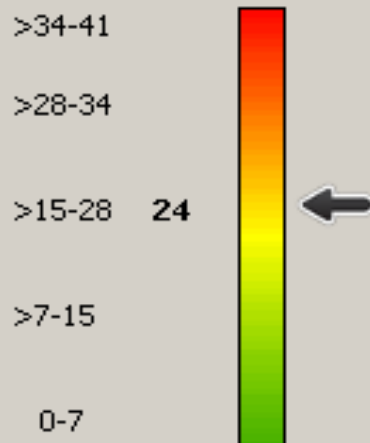
☐ Custom

Qualitative Results

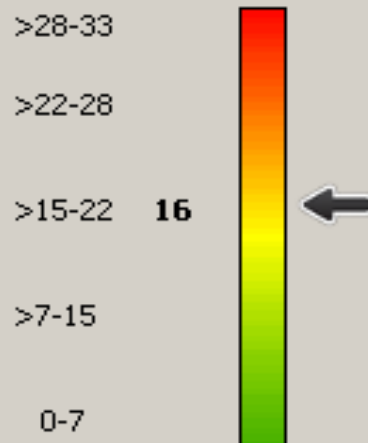
Nitrate Leaching



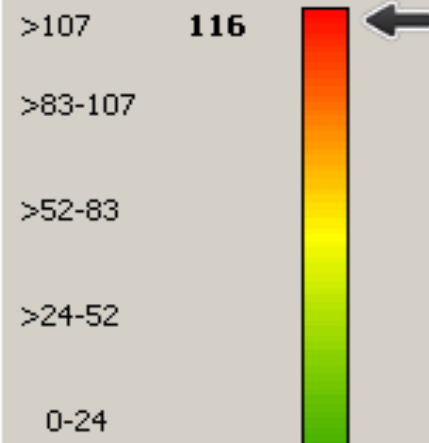
Surface Transport



Atmospheric



Total



N2O Index

Interpretation of Rankings

Definitions of Outputs

Economic Assessment

Ranking Matrix

Save File

Generate Report

Quantitative Results

Total N System In	2824 lbs N / a y	Leaching Index (LI)	6.6 inches
Ammonia Volatilization	6 lbs N / a y	Total Nitrogen Leached	1385 lbs N / a y
Denitrification	338 lbs N / a y	Residual Nitrate	760 lbs N / a y
Above Ground Uptake	334 lbs N / a y	System Use Efficiency	12 %
Ratio N Applied to N Removed by Crop		4.29	

Each Management Category with N Risk

California Nitrogen Index 4.4.1 Matrix Results					
	None or Very Low	Low	Medium	High	Very High
Irrigation System	-	X	-	-	-
Nitrogen Available to Leach Potential	-	-	-	-	X
Estimated Nitrate Leaching	-	-	-	-	X
Aquifer Leaching Risk	-	-	-	X	-
NH3 Volatilization	X	-	-	-	-
Nitrogen Application Rate	-	-	-	-	X
Proximity of Nearest Field Edge to Named Stream or Lake	-	-	X	-	-
Denitrification	-	-	-	-	X
Volatilization Susceptible N Application Method	X	-	-	-	-
Rooting Depths and Crop Rotation	-	-	-	-	X
Soil Erosion (Wind & Water)	-	-	-	-	-
Tile Drainage	X	-	-	-	-
Runoff Class (Runoff Class Table)	-	-	X	-	-
Irrigation Erosion	X	-	-	-	-
Vegetative Buffer	-	-	-	-	X



California Nitrogen Index 4.4.1 | Econ...



Ammonia Volatilization

3.60 \$ / a y (Loss)

Denitrification

202.86 \$ / a y (Loss)

Total N Leached

831.01 \$ / a y (Loss)

Residual Nitrate

456.10 \$ / a y (Loss)

Close

Thank You

